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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN No. 47.

B. T. GALLOWAY, *Chief of Bureau.*

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THE DESCRIPTION OF WHEAT VARIETIES.

BY

CARL S. SCOFIELD,

BOTANIST IN CHARGE OF GRAIN GRADE INVESTIGATIONS.

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

ISSUED AUGUST 18, 1903.

WASHINGTON:

GOVERNMENT PRINTING OFFICE

1903.

BULLETINS OF THE BUREAU OF PLANT INDUSTRY.

The Bureau of Plant Industry, which was organized July 1, 1901, includes Vegetable Pathological and Physiological Investigations, Botanical Investigations and Experiments, Grass and Forage Plant Investigations, Pomological Investigations, and Experimental Gardens and Grounds, all of which were formerly separate Divisions, and also Seed and Plant Introduction and Distribution, the Arlington Experimental Farm, Tea Culture Investigations, and Domestic Sugar Investigations.

Beginning with the date of organization of the Bureau, the several series of Bulletins of the various Divisions were discontinued, and all are now published as one series of the Bureau. A list of the Bulletins issued in the present series follows.

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[Continued on p. 3 of cover.]

Triticum ..... Variety name....., or number .....

Size of plat ..... From ....., 190..

Variety description.

Wheat.

YOUNG STOOL.
Spreading.
Partly spreading.
Erect.
Color.
Yellow green.
Light green.
Medium green.
Dark green.
Gray green.
Purplish.

HALF-GROWN PLANT.
Color.
Light green.
Medium green.
Dark green.
Light yellowish green.
Medium yellowish green.
Dark yellowish green.
Light gray green.
Medium gray green.
Dark gray green.
Leaf blade.
Average length, cm. .....
Average width, cm. .....
Erect.
Ascending.
Drooping.
Smooth.
Scabrous.
Downy.
Glaucous.
Not glaucous.
Veins.
Prominent.
Not prominent.
End of blade.
Tapering.
Sides parallel.
Sheath.
Green.
Green, shading to purple.
Ligule.
Long.
Medium.
Short.
White.
Purple.
Auricles.
White.
Green.
White, with purple tips.
Purple.
Hairy.
Partly hairy.
Smooth.

MATURE PLANT.
Height, cm. .....
Strong.
Medium.
Weak.
Diameter below head, mm. .....
Furrowed.
Medium.
Smooth.
Upper part of culm.
Solid.
Semisolid.
Hollow.
Walls.
Thick.
Medium.
Thin.
Color.
Whitish.
Yellow.
Purple.
Brownish.
Foliage.
Scanty.
Medium.
Abundant.
Rust.
Leaves, %, ...
Stems, %, ...
Smut.
Loose, %, ...
Stinking, %, ...

HEAD. (Field notes.)
Beardless.
Partly bearded.
Bearded.
Erect.
Leaning.
Nodding.
Date of appearance, ...
Date of flowering, ...
Date of maturing. .....
Shattering.
Badly.
Medium.
None.

HEAD (Laboratory notes.)
Length, cm. .....
Very open.
Open.
Medium.
Compact.
Crowded.
Shape.
Tapering toward apex.
Tapering both ways.
Uniform.
Clubbed.
Tip acute.
Tip blunt.
Base abrupt.
Base tapering.
Square.
Flattened with spikelets.
Flattened across spikelets.
Straight.
Slightly curved.
Sterile spikelets, 1, 2, 3, 4, 5, 6, 7.
Color.
Whitish.
Yellow.
Yellowish brown.
Rosy.
Red.
Bluish.
Brown.
Black.

AWNS.
Long.
Medium.
Short.
Slender.
Medium.
Stout.
Orderly.
Medium.
Irregular.
Parallel.
Spreading.
Spreading widely.
Deciduous.
Partly deciduous.
Persistent.
Color.
Whitish.
Brownish.
Yellow.
Black.

SPIKELET.
Spreading widely.
Spreading.
Narrow.
Number of grains, 1, 2, 3, 4, 5, 6, 7.
Basal hairs.
Long.
Medium.
Short.
Wanting.
White.
Brown.
Outer glume.
Hairy, or velvet.
Partly hairy.
Smooth.
Glossy.
Medium.
Dull.
Uniform in color.
Streaked.
Size.
Broad.
Medium.
Narrow.
Long.
Medium.
Short.
Attachment.
Firm.
Medium.
Weak.
Keel.
Broad.
Medium.
Narrow.
Beak.
Long.
Medium.
Short.
Acute.
Blunt.
Shoulder.
Broad.
Medium.
Narrow.
Square.
Sloping.
Round.
Auricle.
Sharp.
Medium.
Blunt.
Wanting.
Auricle notch.
Deep.
Medium.
Shallow.
Wanting.
Apical glumes.
Keeled.
Not keeled.
Notched.
Rounded.
Similar.
Dissimilar.

GRAIN.
Very hard.
Hard.
Medium.
Soft.
Very soft.
Size.
Wt., 100 av. seeds, grams. .....
Shape.
Long.
Medium.
Short.
Curved.
Straight.
Pear-shaped.
Thin.
Medium.
Plump.
Flat-cheeked.
Plump-cheeked.
Angular-cheeked.
Pointed at tip.
Pointed at base.
Blunt at tip.
Blunt at base.
Color.
Whitish.
Yellowish.
Clear amber.
Dull amber.
Clear red.
Dull red.
Brush.
Large.
Small.
Long.
Short.
Crease.
Deep.
Medium.
Shallow.
Wide.
Medium.
Narrow.
Cross section.
Very horny.
Horny.
Dull.
Starchy.

MILLING QUALITIES.
First class.
Good.
Medium.
Poor.

GENERAL CHARACTERISTICS.
Hardy.
Medium.
Delicate.
Early.
Medium.
Late.
Days maturing, ...
Autumn planted.
Spring planted.
Drought resistance.
Good.
Medium.
Poor.
Yield.
Per plant, ...
Per acre. .....

FORM USED IN THE DESCRIPTION OF WHEAT VARIETIES.

	Tritic r number .....
	Size o ....., 190..
Variety description.	**YOUNG STOO**-shaped.
	Spreading. .
Wheat.	Partly sprea ium.
	Erect. ap.
	Color. -cheeked.
	Yellow gree ap-cheeked.
	Light green ular-cheeked.
	Medium gre ted at tip.
	Dark green. ted at base.
	Gray green. t at tip.
	Purplish. t at base.
	HALF-GROW ish.
	Color. owish.
	Light green r amber.
	Medium gre amber.
	Dark green. r red.
	Light yello red.
	Medium yel
	Dark yellow e.
	Light gray g.
	Medium gra.
	Dark gray g t.
	Leaf blade.
	Average len .
	ium.
	Average wi ow.
	Erect. e.
	Ascending. ium.
	Drooping. ow.
	Smooth. ection.
	Scabrous. horny.
	Downy. y.
	Glaucous. .
	Not glaucou hy.
	Veins.
	Prominent. **NG QUALITIES.**
	Not promine class.
	End of blade. d.
	Tapering. ium.
	Sides paralle.
	Sheath.
	Green. **RAL CHARACTERISTICS.**
	Green, shad y.
	Ligule. ium.
	Long. cate.
	Medium. y.
	Short. ium.
	White. .
	Purple. s maturing, ...
	Auricles. umn planted.
	White. ng planted.
	Green. *ht resistance.*
	White, with d.
	Purple. ium.
	Hairy. .
	Partly hairy
	Smooth. plant, ...
	MATURE PLA acre, ...
	Height, cm.

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THE DESCRIPTION OF WHEAT VARIETIES.

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CARL S. SCOFIELD,

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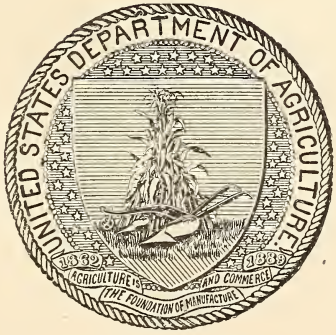
BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

Issued August 18, 1903.



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1903.

BUREAU OF PLANT INDUSTRY.

B. T. Galloway, *Chief of Bureau.*

BOTANICAL INVESTIGATIONS AND EXPERIMENTS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., June 15, 1903.

Sir: I have the honor to transmit herewith, and to recommend for publication as Bulletin No. 47 of the series of this Bureau, the accompanying paper entitled "The Description of Wheat Varieties." This paper was prepared by Mr. Carl S. Scofield, of this Bureau, and has been submitted by the Botanist with a view to publication.

The seven half-tone plates are essential for the purposes of this bulletin.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

With the exception of Indian corn, wheat is the most important cereal crop of the United States, and it therefore has been and will continue to be the object of much experimentation. Being a close-fertilized plant and consequently unable to cross pollinate in nature, wheat naturally maintains stronger hereditary lines than do open-fertilized crops under similar conditions, and therefore the variations that do occur more commonly retain their identity. In other words, wheat under cultural conditions tends to break up into varieties. Unlike many of our horticultural and garden crops, wheat has not up to this time been given the careful comparative study that its importance merits, and consequently the greatest confusion exists in the nomenclature of its varieties. For this reason important conclusions reached in one locality by costly experiments may be wholly misapplied in another locality.

It is important to have, as a basis for careful and intelligible experimentation with wheat, a correct understanding of variety names, and the important varieties of our American wheats should be carefully described and illustrated. Ordinarily in comparing the varieties of an agricultural plant it is the practice to gather a large series of samples of seed and grow the varieties side by side, making descriptions from the plants thus grown. By such a plan many of the varieties, being subjected to climatic and soil conditions to which they are not adapted, fail to develop their special and proper characteristics, and numerous complications arise. In undertaking the task of recording the characters of wheats, it is deemed advisable first to secure accurate descriptions of the varieties as they are found in the regions to which they are best adapted.

It is believed that the method of description herewith set forth will interest wheat experimenters in this important phase of their work, and lead to the adoption of some arrangement whereby wheat variety names may have a distinctly more definite meaning than at present.

FREDERICK V. COVILLE,
Botanist.

OFFICE OF BOTANICAL INVESTIGATIONS AND EXPERIMENTS,
Washington, D. C., May 20, 1903.

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II. Three different types of wheat having the same name. Natural size 19

III. Fig. 1. Auricles and ligules of wheat leaves. Enlarged seven times. Fig. 2. Types of wheat spikes. Natural size 19

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VII. Outer glumes from various types of wheat spikelets. Enlarged seven times 19

THE DESCRIPTION OF WHEAT VARIETIES.

INTRODUCTION.

The nomenclature of the varieties of wheat now growing in the United States is somewhat tangled. The wheat plant is particularly unstable in type and a change of environment is likely to cause variations and result in plants better fitted to the new conditions. These plants, by producing more seed or seed of better quality, are the more vigorous progenitors, and gradually a complete change of type results. Other causes, such as errors in labeling seed packages for distribution, or the mixture of varieties by machines used in harvesting and thrashing, or by slight mixtures from the sacks and bins in which grain is stored, have all aided in bringing about an unfortunate confusion in the names of our standard varieties of wheat.

The origination of new varieties has also added its share to this confusion. These new varieties may have resulted from accidental or intentional hybridization, or merely by selection on the part of some enthusiast of seed from some plant that has attracted attention. The new variety may resemble one already existing so closely as to be indistinguishable, or it may be an entirely new form. In either case it is probably given a name without being anywhere even vaguely described or registered. The law of the survival of the fittest applies to wheat varieties as to other plants, and the poorer varieties in time give place to better sorts; but unfortunately the name frequently survives and immediately attaches to some other form.

In all literature regarding variety tests for comparative yield, adaptability, or hardiness, in fact in all discussions regarding wheat varieties, it is necessary to designate each by a name. In order to avoid hopeless confusion in so doing, it is essential that some system be used whereby these names may have a definite meaning; that is, that each name be connected with some one particular variety or type of wheat. This has been found absolutely necessary with all natural plants and with most of our cultivated horticultural and garden crops.

In connection with some work on American wheat varieties undertaken for the United States Department of Agriculture, a large number of varieties of wheat were collected from State experiment stations and some other sources with a view to describing and illustrating the

standard sorts. It was found, however, that such an undertaking would be nearly impossible, for the present. Among the wheats so collected, cases were found where samples indistinguishable as to botanical characters were known by several different names, while on the other hand there were cases where one name was found serving for several samples strikingly different in appearance. (See Pls. I and II.)

A search through the available literature dealing with wheat varieties, chiefly experiment station bulletins and seed catalogues, giving accounts of new varieties and variety tests, showed that in most cases the wheats were either not described at all or had descriptions so meager and indefinite as to be useless.

The description of a wheat plant is, in itself, not a difficult undertaking, but it requires the consideration of a number of details which are sometimes hard to keep in mind or to find the right adjectives to fit. In order to reduce this work to the simplest terms, a form for variety descriptions has been prepared, a copy of which is inserted at the beginning of this bulletin. On this form are listed, in regular order, such adjectives as are deemed of the most importance in describing a variety of wheat. These adjectives are sufficiently numerous to express practically all ordinary conditions met in describing a variety. In order to make the description one needs only to glance at the form, note the alternatives mentioned regarding a certain characteristic, then to glance at the sample in hand to see which of the adjectives most nearly applies; this one is then checked, and the next set of adjectives taken up. This method greatly facilitates the work of describing varieties by suggesting the adjectives and by saving the trouble of writing out the words used. It also gives a basis for uniform description in all cases, which is a matter of prime importance.

The form is printed on strong, thin paper, which may be filed in any manner desired and preserved for future reference. All the data regarding any plant or variety for a given year are thus brought together on a single sheet of paper.

It is believed that this system offers the means of straightening out the nomenclature of our wheat varieties, of preventing errors in distributing wheat samples for testing purposes, of studying the effect of changes of environment on wheat varieties, and of noting the variations resulting from hybridization. New varieties that may be originated may be, by this method, accurately described, and if it is found desirable these new varieties, so described, may be registered by some recognized and competent organization.

Further than this, published results of variety tests, when supplemented by more accurate descriptions, will be infinitely more valuable to the reader than they are at present.

The idea of describing wheats by a printed form was suggested by Dr. N. A. Cobb, government botanist of New South Wales.

EXPLANATION OF FORM.

The heading of the form has spaces for writing in the variety name or number, the place where grown, and the year grown. There is also space for giving size of plat or field grown, or, in case very small plats or single plants are the basis of the description, the number of plants should be stated. After the word *Triticum* the species, whether *æstivum* (*vulgare*) or *durum*, should be written. This form is made up to describe varieties of these two species only. Varieties of the other species of *Triticum* are not extensively enough known or cultivated in this country to warrant the expansion of this form to include their description.

The adjectives used on this form are grouped under the following heads: 1, Young stool; 2, Half-grown plant; 3, Mature plant; 4, Head (field notes); 5, Head (laboratory notes); 6, Awns; 7, Spikelet; 8, Grain; 9, Milling qualities; 10, General characteristics.

Young stool.—The terms *spreading*, *partly spreading*, and *erect* apply to the general form of growth of the young plant before the appearance of the stem. In case of wheats planted in the autumn, these observations should be made in the late autumn or very early spring.

The shades of color are comparative and difficult to describe accurately and can be noted to the best advantage only when plats of grain may be compared side by side.

Half-grown plant.—By this is meant the stage of growth when the head is just appearing from the sheath of the upper leaf; in other words, just before flowering time. The shades of color are here again difficult to describe and can be noted with any degree of accuracy only when comparison between plats of grain is possible.

The measurements of the leaf blade should be taken on the upper leaf of each of at least ten average plants, when that many are available, the maximum measurement of each dimension of the leaf being the one used in averaging. The terms *erect*, *ascending*, and *drooping* apply to the upper leaf after the head is well out of the sheath, and the terms *smooth*, *scabrous*, and *downy* apply to the surfaces of the leaf blade and to the leaf sheath. The term *glaucous* is defined as "covered with a bluish-white bloom" and refers to the surface of the young leaves.

The terms *prominent* and *not prominent* applied to the veins of the leaf are difficult of accurate definition and should be considered only when comparison of varieties is possible.

The terms *tapering* and *sides parallel* applied to the end of the leaf blade deal with the general shape of the distal one-third of the upper leaf.

The sheath is that portion of the leaf which clasps the stem, and the color terms here used are self-explanatory.

The ligule (Pl. III, fig. 1) is the thin, transparent tissue borne at the juncture of the blade and sheath of the leaf and clasping the stem above the leaf. The terms *long*, *medium*, and *short* apply to the height this tissue reaches up the stem. A ligule 2.5 mm. or longer is considered long, while one 2 mm., more or less, is medium, and it is short when less than about 1.7 mm.

The leaf auricles (Pl. III, fig. 1, No. 2) are the thin projections of tissue which are the outgrowths from the base of the leaf blade or from the thickened tissue at the juncture of the blade and sheath of the leaf. The terms applying to these need no explanation.

Mature plant.—The height measurement is marked to be stated in centimeters and, whenever possible, should be made when the plant is still standing in the field in its natural position. The terms *strong*, *medium*, and *weak* apply to the general vigor of the plant, including its ability to stand erect and its branching or "stooling." The *diameter below the head* should be measured at the point where the straw is smallest, between the upper leaf and the base of the spike. When this measurement is made some sort of calipers must be used. The terms *furrowed*, *medium*, and *smooth* apply to the surface of the straw, and these terms should be used only where straws may be compared side by side, as all wheat straws are more or less furrowed.

The terms *solid*, *semisolid*, and *hollow* (Pl. V, figs. 1, 2, and 3) apply to the amount of pith in the culm about halfway between the top of the upper leaf sheath and the base of the head, solid being used when the straw is entirely full of the pith, semisolid when only a very small hole through the center of the straw is open, and hollow when the pith is entirely absent or consists only of a thin layer on the inside of the culm.

The terms *thick*, *medium*, and *thin* applied to the walls of the culm are relative, and can be stated only after comparing different plants. In considering the thickness of the walls, the layer of pithy tissue on the inside must not be included as part of the wall. The thickness of the wall indicates to some extent the rigidity of the culm and the ability of the plant to stand erect.

The color terms here are applied to the culm after the plant is completely matured and are, as before, only comparative.

The terms *scanty*, *medium*, and *abundant*, applying to the foliage, should be marked only when opportunity is had of seeing various plats of grain together under similar conditions.

The percentage of rust for leaves and stems must be estimated, considering 100 per cent damage in either case as applying to cases where the surface of the leaves or stem is completely covered with rust pustules, and zero per cent when no rust is observed. This estimate may be based on a single plant or on a whole plat of grain, as occasion requires.

When estimating smut of either sort the same is true. When every

grain in the head or in every head is infected the percentage is 100, and zero when the plant or plat is entirely free from smut.

Head (*field notes*).—The term *beardless* is applied to those heads the flowering glumes of which bear no awns longer than 1 centimeter; *partly bearded* where some of the flowering glumes bear awns longer than 1 centimeter while others bear awns much shorter, and *bearded* when all the flowering glumes bear awns longer than a centimeter. The terms *erect*, *leaning*, and *nodding* apply to the way the head is borne by the stem at or after maturity. The dates of appearance, flowering, and maturing need no explanation.

The terms *shattering badly*, *medium*, and *none* apply to the ability of the glumes to hold the grain after maturity. These are only comparative terms, as this is a quality difficult of actual measurement, but it is an item of great importance in all the large wheat-producing regions and should be most carefully considered.

Head (*laboratory notes*).—The length measurement should be taken from the lowest joint of the head to the tip of the apical flowering glume, not counting the awn if one is borne by this glume. The terms *very open* (Pl. III, fig. 2, No. 1), *open*, *medium*, *compact*, and *crowded* (Pl. III, fig. 2, No. 2) apply to the way the spikelets are borne in the head. These are relative terms, since the size of the spikelet has some influence in this matter, making the statement of this quality by giving the distance between the joints unsatisfactory.

Under shape of spike, the term *tapering toward apex* should be applied to those which taper gradually from about the middle or below. *Tapering both ways* should be applied to those spikes which are spindle-shaped or larger in diameter at the middle than at either end. *Uniform* (Pl. III, fig. 2, No. 1) applies to those spikes which are very nearly the same diameter throughout their length. *Clubbed* (Pl. III, fig. 2, No. 2) should be applied to those spikes which are larger at the tip than below. The term *tip acute* (Pl. III, fig. 2, No. 1) is applied to those spikes which terminate with one or two undeveloped spikelets, and *tip blunt* (Pl. III, fig. 2, No. 2) to those having terminal spikelets well filled out; *base abrupt* to those having basal spikelets well developed, and *base tapering* to those having the basal spikelets very small or undeveloped. *Square* applies to those spikes the diameters of which through and across the spikelets are about the same, and *flattened with spikelets* (Pl. III, fig. 2, Nos. 5 and 6) to those spikes which have the diameter through the spikelets smaller than the diameter across the individual spikelet, the condition commonly found in *Triticum æstivum;* while *flattened across spikelets* (Pl. III, fig. 2, Nos. 3 and 4) applies to those spikes having the diameter through the spikelets greater than that across them, the condition common to the varieties of *Triticum durum*. The terms *straight* and *slightly curved* need no explanation.

The color terms are again relative.

Awns.—The terms *long*, *medium*, and *short* are only comparative, as are the terms *slender*, *medium*, and *stout*. The terms *orderly*, *medium*, and *irregular*, and *parallel*, *spreading*, and *spreading widely* apply to the way the awns stand in relation to the head. *Orderly* is used when the awns are uniform in length or position, and *irregular* when some of them are long and others short or when some are parallel to the spike and others twisted or divergent. *Deciduous*, *partly deciduous*, and *persistent* apply to the way the awns are retained after the plant reaches maturity. Some plants normally have awns so brittle that they break at the point of juncture with the flowering glume soon after the plant reaches maturity.

The color terms again are relative.

Spikelets.—The terms *spreading widely*, *spreading*, and *narrow* apply to the width of the spikelet, or the way the glumes are set. Plate IV shows extreme cases of the width of spikelets. The *number of grains per spikelet* means the number of grains borne in an average well-developed spikelet.

The structure of the spikelet and the shape of the various glumes are of such importance in describing wheat varieties that they deserve special attention. The spikelet is composed of several flowers borne alternately on a short branch of the spike called the rachilla, and subtended by two large bracts, or outer, empty glumes. These glumes are hereafter called the outer glumes and should not be confused with the flowering glume which surrounds each flower or grain. The long awns of the spike, when present, are borne on the flowering glumes. The outer glumes never bear awns longer than two or three centimeters.

In Plate V, fig. 13, is shown a spikelet split apart to show the rachilla and the way the glumes are borne, and in the same plate (fig. 19) is shown the compound spikelet found in the so-called Mummy wheat, or Seven-headed wheat. In the latter case the spike is branched and each branch, in turn, bears true spikelets.

There is usually borne on the rachis at the base of each spikelet, below the outer glumes, a growth of short, bristly hairs (Pl. IV, fig. 1) which are here called basal hairs and which may be described by the terms *long*, *medium*, *short*, and *wanting*, and in color either *white* or *brown*. These hairs should not be confused with the hairs sometimes present on the outer glumes.

The outer glume may be either hairy, partly hairy, or smooth. Plate VII, figs. 4 and 6, shows types of hairy and smooth glumes, while in Plate V, fig. 14, is shown a spikelet of which not only the outer glumes are hairy but also the flowering glumes as well. The terms *glossy*, *medium*, and *dull* apply to the surface of the outer glume, as do the terms *uniform in color* and *streaked*.

The terms *broad*, *medium*, and *narrow* apply to the shape of the outer glume; that is, to the way the wings on either side of the keel

fit around the flowering glume. Plate IV, fig. 2, shows a spikelet with narrow outer glume, while in Plate V, fig. 19, the glumes on the compound spikelet are relatively broad. The terms *long*, *medium*, and *short* apply to the relative length of this outer or flowerless glume. The spikelet in Plate IV, fig. 2, has short outer glumes, while the spikelet in fig. 1 has long glumes; that is, glumes nearly or quite as long as the flowering glumes.

The terms *firm*, *medium*, and *weak* under *attachment* have to do with the firmness of the attachment of the glumes, when ripe, to the rachilla upon which they are borne. This firmness of attachment indicates the ability of the glumes to retain the grain after the plant reaches maturity.

The keel of the outer glume is the pronounced central nerve and may be broad, medium, or narrow. Varieties of *Triticum durum* are characterized by the broad keel (Pl. VII, fig. 1) which is prominent throughout its entire length. The keel is always present, but may not be distinct in some varieties of *Triticum æstivum*.

The beak of the outer glume is the tip of the keel. It may be either long (Pl. VI, figs. 6 and 7), medium (fig. 5), or short (figs. 1 and 2), and acute or blunt.

The shoulder of the outer glume is that portion on either side of the midrib at the tip of the glume and it may be either broad (Pl. VI, fig. 2), medium (fig. 1), or narrow (fig. 5), and square (Pl. VII, fig. 5), sloping (fig. 1), or round (fig. 6).

The auricle of the outer glume (Pl. VII, fig. 5) occurs, when present, at the tip of the shoulder, which is sometimes extended into a distinct ear. It may be sharp (Pl. VI, fig. 4), medium, blunt (fig. 1), or wanting (fig. 3).

The auricle notch (Pl. VII, fig. 5) is the notch in the tip of the outer glume between the auricle and the beak. It may be deep (Pl. VI, fig. 1), medium, shallow (fig. 7), or wanting (fig. 5).

The apical glumes are the outer glumes of the apical spikelet, and they sometimes show distinct differences. Two types of these outer glumes, of which there are but two on each spike, are shown in Plate VII, figs. 2 and 3. These glumes may be keeled or not keeled, notched or rounded, and they may be similar or dissimilar.

Grain.—The terms *very hard*, *hard*, *medium*, *soft*, and *very soft* are only comparative, but are convenient in distinguishing between different sorts of grain.

The size is determined by weighing 100 average seeds. This determination should be made in duplicate, at least.

The terms *long*, *medium*, and *short*, applying to the shape of the grain, are only comparative. They apply to the relative length and diameter of the grain. Extreme types are shown in Plate V. The grain may also be either curved (fig. 4), straight (fig. 6), or pear shaped (fig. 8). The pear-shaped grain is the kind sometimes known as club wheat.

The term *clubbed* has been applied indiscriminately to either the shape of the head or the shape of the grain, but in the accompanying form the word *clubbed* is reserved to describe the shape of the head, while the term *pear-shaped* is used for the grain. The grain may be thin, medium, or plump, and flat-cheeked, plump-cheeked (Pl. V, fig. 12), or angular-cheeked (fig. 10), the cheek of the grain here meaning the portion on either side of the crease. It may also be pointed or blunt at the tip and pointed or blunt at the base.

The color terms are again only comparative.

The brush of the grain is the growth of hair at the tip or the end opposite the germ. The terms *large* and *small* apply to the area over which the brush is borne, and the terms *long* and *short* apply to the length of the hairs. The grain of *Triticum durum* is characterized by the extreme shortness of the brush (Pl. V, fig. 4), but some slight growth of hair is always present, even in varieties of this species.

The crease of the grain is the indentation extending along the side opposite the germ. This crease may be deep, medium, or shallow; that is, the portion of the endosperm between the bottom of the crease and the outer skin of the berry may be thick or thin and the crease may be either wide, medium, or narrow. The cross sections of the grain shown in Plate V, figs. 10, 11, and 12, give a good example of extreme cases of this characteristic. The terms *very horny*, *horny*, *dull*, and *starchy* apply to the texture of the grain in cross section.

Milling qualities..—The terms *first-class*, *good*, *medium*, and *poor* are purposely indefinite here because it is impossible to give in so brief a space more definite expression of the characters which go to determine the milling qualities of the wheat and the terms used give at least an idea of the opinion of the observer.

General characteristics.—The terms *hardy*, *medium*, and *delicate*, *early*, *medium*, and *late* need no explanation. The *days maturing* should be given as the time from the planting of the grain until the plant is fully matured. *Autumn planted* and *spring planted* refer to the season of the year when the grain was sown. *Drought resistance* is a term applied to the ability of wheats to mature well under droughty conditions; the adjectives *good*, *medium*, and *poor* serve to indicate the observer's idea of the relative merits of a variety in this regard. The amount of yield should be stated in grams per plant or bushels per acre.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. Two examples of different types of wheat having the same name. Natural size. Fig. 1.—The type of a variety known as Early Ripe, from the Ohio State Experiment Station. Fig. 2.—The type of the variety Early Ripe, from the Oklahoma Experiment Station. Fig. 3.—The type of a variety known as Emporium, from the Washington State Experiment Station. Fig. 4.—The type of the variety Emporium, from the Utah Experiment Station.

PLATE II. Three different types of wheat having the same name. Natural size. Fig. 1.—A beardless, smooth-chaffed wheat, known as Velvet Chaff, from the Utah State Experiment Station. Fig. 2.—A beardless, hairy-chaffed wheat, known as Velvet Chaff, from the Colorado State Experiment Station. Fig. 3.—A bearded, hairy-chaffed wheat, known as Velvet Chaff, from the Ohio State Experiment Station.

PLATE III. Fig. 1.—Auricles and stipules of wheat leaves. Enlarged seven times. Showing point of juncture of blade and sheath of the leaf. No. 1.—The stem removed to show the entire ligule. No. 2.—The leaf in natural position, with the sheath clasping the stem. Fig. 2.—Types of wheat spikes. Natural size. No. 1.—Spike beardless, nine centimeters long, very open, uniform, tip acute, base tapering, flattened with the spikelets, and straight; glumes smooth. No. 2.—Spike bearded, eight centimeters long, crowded, clubbed, tip blunt, base tapering, square and straight; glumes hairy. Nos. 3 and 4.—Spike of *T. durum* shown in two positions to illustrate "flattened across spikelets." The diameter of the spike *through* the spikelets (No. 3) is *greater* than *across* the spikelets (No. 4.) Nos. 5 and 6.—Spike of *T. æstivum* shown in two positions to illustrate "flattened with spikelets." The diameter of the spike *through* the spikelets (No. 5) is *less* than *across* the spikelets (No. 6.)

PLATE IV. Different types of wheat spikelets. Enlarged five times. Fig. 1.—A narrow spikelet containing three grains with long basal hairs, and with long, smooth, narrow outer glumes, each with a narrow keel and a long, acute beak; the flowering glumes firmly attached, and with the awns of two of them broken off. Fig. 2.—A broad spikelet containing five grains with short basal hairs, and with short, smooth, narrow outer glumes, each with a narrow keel and a very short, blunt beak. The flowering glumes are firmly attached, and, while each has an awn, these are so short that the spike would be called beardless.

PLATE V. Various types of culms, grain, and spikelets. Twice natural size. Fig. 1.—Culm solid. Fig. 2.—Culm semisolid. Fig. 3.—Culm hollow. Fig. 4.—Grain long, curved; brush short. Fig. 5.—Grain short, tip blunt, base pointed; brush large, long. Fig. 6.—Grain medium length, straight; tip blunt, base pointed; brush short. Fig. 7.—Grain short; tip and base pointed; brush small, long. Fig. 8.—Grain short, pear-shaped; tip pointed, base blunt; brush small, long. Fig. 9.—Grain short, straight; base and tip blunt; brush large, long. Fig. 10.—Section of grain showing angular cheek, with crease deep and narrow. Fig. 11.—Section of grain showing plump cheek, with crease deep and broad.

TWO EXAMPLES OF DIFFERENT TYPES OF WHEAT HAVING THE SAME NAME.
NATURAL SIZE.

THREE DIFFERENT TYPES OF WHEAT HAVING THE SAME NAME.
NATURAL SIZE.

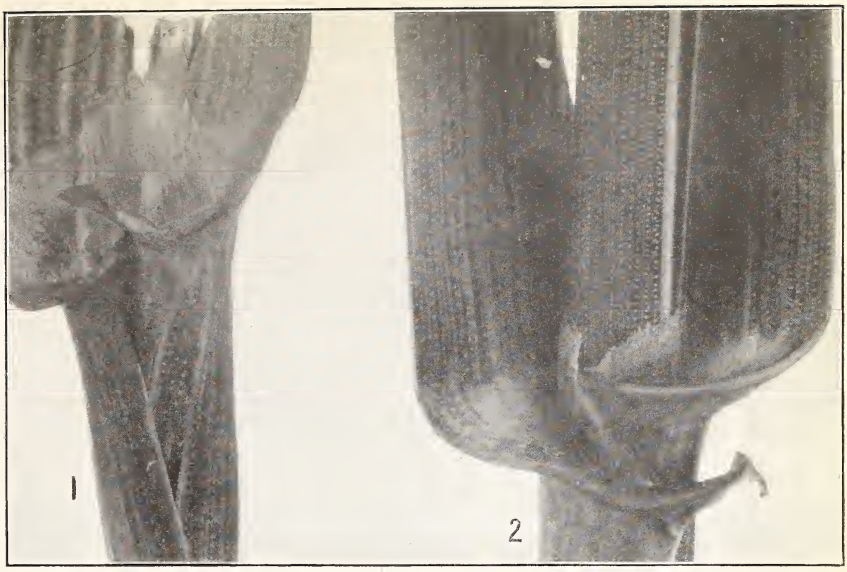
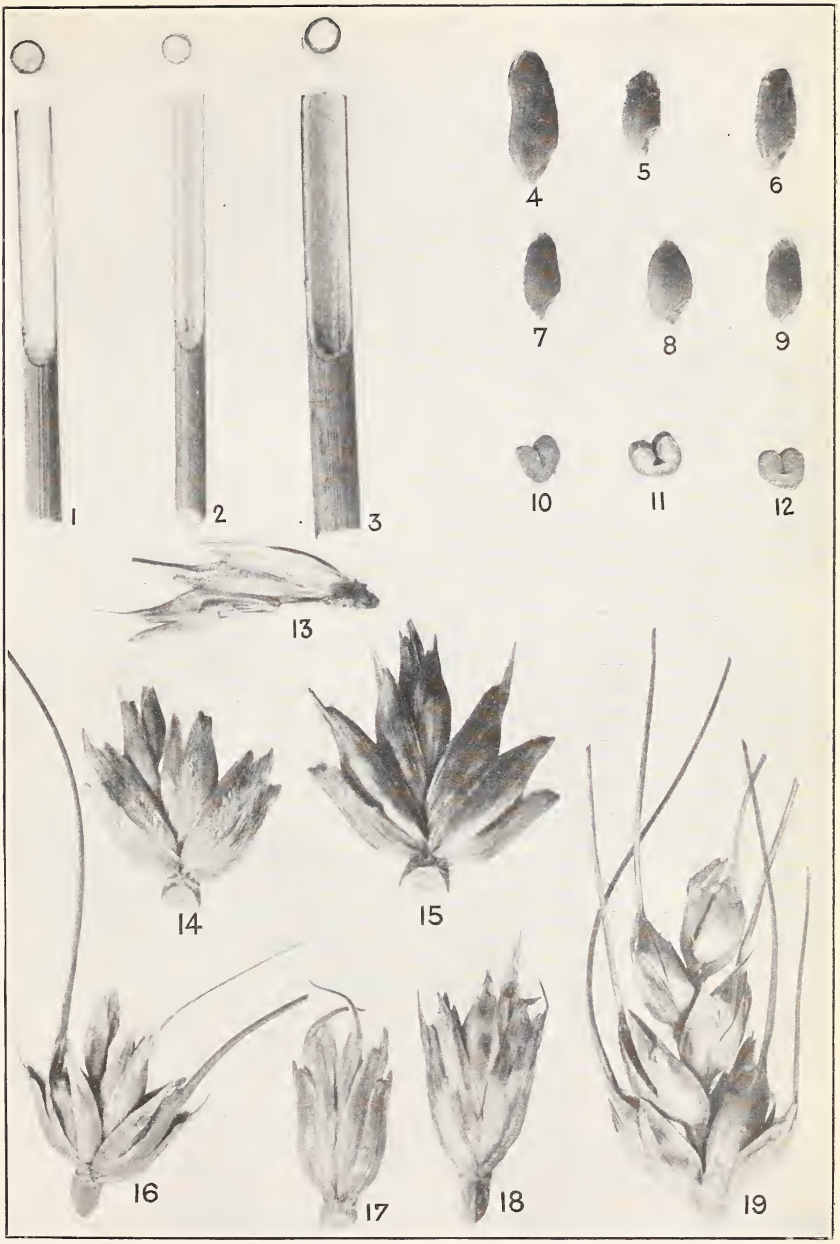


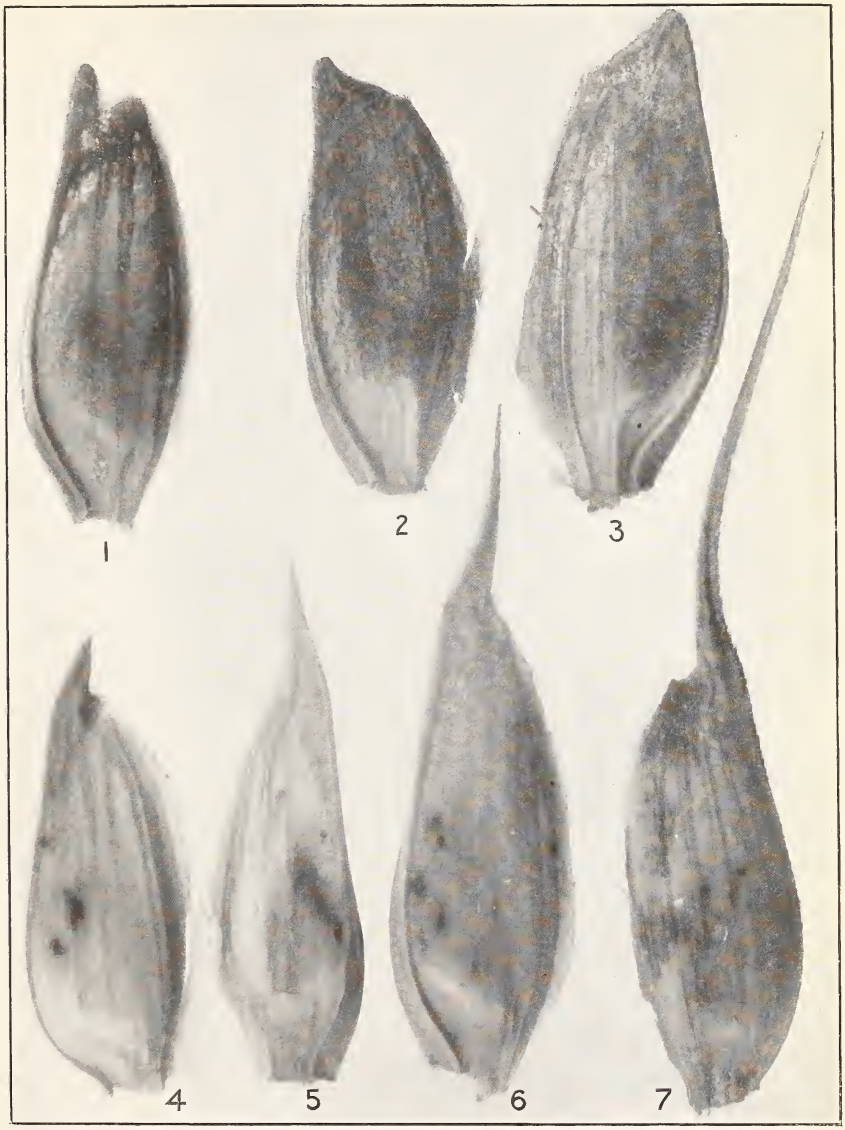
FIG. 1.—AURICLES AND LIGULES OF WHEAT LEAVES. ENLARGED SEVEN TIMES.

FIG. 2.—TYPES OF WHEAT SPIKES. NATURAL SIZE.

DIFFERENT TYPES OF WHEAT SPIKELETS. ENLARGED FIVE TIMES.



VARIOUS TYPES OF CULMS, GRAIN, AND SPIKELETS. TWICE NATURAL SIZE.



OUTER GLUMES FROM VARIOUS TYPES OF WHEAT SPIKELETS. ENLARGED SEVEN TIMES.

OUTER GLUMES FROM VARIOUS TYPES OF WHEAT SPIKELETS. ENLARGED SEVEN TIMES.

Fig. 12.—Section of grain showing plump cheek, with crease medium deep and narrow. Fig. 13.—Portion of spikelet showing rachilla and arrangement of glumes. Fig. 14.—Simple spikelet, beardless, spreading; glumes hairy, medium length; beak short and blunt. Fig. 15.—Simple spikelet, beardless, spreading widely; glumes smooth, short; beak short and blunt. Fig. 16.—Simple spikelet, bearded, spreading; glumes smooth, short, attachment weak; beak long and acute. Fig. 17.—Simple spikelet, beardless, narrow; glumes smooth, medium length; beak medium and blunt. Fig. 18.—Simple spikelet, beards broken off, narrow; glumes smooth and long; beak long and acute. Fig. 19.—Compound spikelet from "seven-headed" wheat; bearded; glumes smooth, medium length, broad; beak short and acute.

PLATE VI. Outer glumes from various types of wheat spikelets. Enlarged seven times. Fig. 1.—Glume smooth, medium size; keel narrow; beak short and blunt; shoulder medium and square; auricle medium, notch deep. Fig. 2.—Glume smooth, broad, medium length; keel narrow; beak short and blunt; shoulder broad and sloping; auricle wanting. Fig. 3.—Glume similar to fig. 2, but from the other side of spikelet. Fig 4.—Glume smooth, broad, and short; keel narrow; beak short and acute; shoulder medium and round; auricle sharp; notch medium. Fig. 5.—Glume smooth, medium size; keel narrow; beak medium and acute; shoulder narrow and sloping; auricle wanting. Fig. 6.—Glume smooth, long, and broad; keel narrow; beak long and acute; shoulder narrow and sloping; auricle wanting. Fig. 7.—Glume smooth, medium size; keel narrow; beak long and acute; shoulder medium and round; auricle sharp; notch shallow.

PLATE VII. Outer glumes from various types of wheat spikelets. Enlarged seven times. Fig. 1.—Glume smooth, broad, and long; keel broad; beak short and acute; shoulder medium and sloping; auricle wanting. Fig. 2.—Outer glume from an apical spikelet, notched and without a keel. Fig. 3.—Outer glume from an apical spikelet, notched and keeled. Fig. 4.—Glume hairy, medium, and short; keel narrow; beak long and acute; shoulder medium and square; auricle wanting. Fig. 5.—Glume smooth, medium sized; keel narrow; beak short and blunt; shoulder medium and square; auricle medium; notch deep. Fig. 6.—Glume hairy, short, and broad; keel narrow; beak short and acute; shoulder broad and round; auricle wanting.

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